DMT Overall Tasks

**Algorithms**
- Implementation
- Verification
- Validation assistance

**Software**
- Maintenance
- Configuration management

\[ Z = \sum_{i=0}^{n} \left( \sum_{j=1}^{m} \left( \frac{\Delta C_i}{\sigma C_i} \right)^2 + \left( \frac{\Delta y_j}{\sigma y_j} \right)^2 \right) + \sum_{k=1}^{l} \left( \frac{\Delta F_k}{\sigma F_k} \right)^2 \]

where on the r.h.s. the first term represents the cloud fraction adjustments of the model variable adjustments, and the third term the flux components.

Equation (4) below restricts the solution such that the sum of the changes is zero. This prevents unrealistic solutions (i.e., sum of adjusted total fluxes).
DMT-ASDC Interface

Science Team

Data Management Team (DMT)

Atmospheric Science Data Center (ASDC)

Funded by Radiation Budget Measurements WBS

Funded by ESDIS
Recent and Ongoing DMT Activity
MODERNIZATION
Production Code

- Deprecated file formats
- Million lines of code
- Contingency Planning (workforce, spacecraft)
- User experience (metadata, display)
File Formats

• Eliminating extraneous files:
  • IES
  • Binaries
  • Temp
• Output file format:

  File format code deliveries start: mid-December, 2019
Metadata

- Universal Metadata Model
- CF Compliance
- Data Product Developers’ Guide (DPDG), Beta
Subsetter/Ordering Tool

- Emphasis on availability and flexible ordering
- Migrations:
  1. As-is virtualization
  2. Redesigned, containerization (OpenShift)

### Energy Balanced and Filled (EBAF)

Climate Data Record (CDR) of monthly TOA fluxes and consistent computed surface fluxes and clouds suitable for analysis of variability at the intra-seasonal, inter-annual, and longer time scales.

<table>
<thead>
<tr>
<th>Data Product Information</th>
<th>Description</th>
<th>Parameter</th>
<th>Resolution</th>
<th>Version/Availability</th>
<th>Order Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBAF</td>
<td>Monthly and climatological averages of observed TOA and computed surface all-sky, clear-sky (spatially complete), and cloud radiative effect (CRE) fluxes and associated clouds. The TOA net flux is constrained to the ocean heat storage. <a href="#">EBAF Data Quality Summary</a></td>
<td><img src="#" alt="Info" /></td>
<td><img src="#" alt="Info" /></td>
<td><img src="#" alt="Info" /></td>
<td>Browse &amp; Subset</td>
</tr>
</tbody>
</table>

### Synoptic TOA and surface fluxes and clouds (SYN)


Product Availability
<table>
<thead>
<tr>
<th>Product</th>
<th>Platform</th>
<th>Processed Thru</th>
<th>Publically Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDS</td>
<td>Terra, Aqua</td>
<td>June ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SSF</td>
<td>Terra, Aqua</td>
<td>June ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SSF1deg-Hour</td>
<td>Terra, Aqua</td>
<td>May ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SSF1deg-Day/-Month</td>
<td>Terra, Aqua</td>
<td>May ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SYN1deg-Hour/3Hour/MHour</td>
<td>Terra+Aqua</td>
<td>May ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SYN1deg-Day/-Month</td>
<td>Terra+Aqua</td>
<td>May ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>Product</td>
<td>Platform</td>
<td>Processed Thru</td>
<td>Publically Available?</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>CldTypHist</td>
<td>Terra+Aqua</td>
<td>Apr. ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>FluxByCldTyp</td>
<td>Terra+Aqua</td>
<td>Fall ‘19</td>
<td></td>
</tr>
<tr>
<td>EBAF ToA + Surface</td>
<td>Terra+Aqua</td>
<td>May ‘19*</td>
<td>No*</td>
</tr>
<tr>
<td>EBAF ToA</td>
<td>Terra+Aqua</td>
<td>June ‘19</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Under review for release, post-Science Team Meeting
<table>
<thead>
<tr>
<th>Product</th>
<th>Platform</th>
<th>Processed Thru</th>
<th>Publically Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDS</td>
<td></td>
<td>July ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SSF</td>
<td>Terra, Aqua</td>
<td>July ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SSF1deg-Hour</td>
<td></td>
<td>June ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SSF1deg-Day/-Month</td>
<td></td>
<td>June ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SYN1deg-Hour/3Hour/MHour</td>
<td>Terra+S-NPP</td>
<td>June ‘19</td>
<td>Yes</td>
</tr>
<tr>
<td>SYN1deg-Day/-Month</td>
<td></td>
<td>Nov. ‘17</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Upcoming/Recent Editions

<table>
<thead>
<tr>
<th>Edition</th>
<th>Details</th>
</tr>
</thead>
</table>
| Ed 1 J1/NOAA-20 | - Sensor gain has stabilized  
- Accommodate LW channel |
| Ed 2 S-NPP | - Incorporate updated VIIRS data  
- FM5: same radiometric scale as FM3 |
| EBAF 4.1 | - Only either C5 or C6.1 MODIS  
- C6.1-based MATCH aerosols  
- Corrected Clouds inconsistencies |
Code Re-architecture
CERES Code Goals

First Priority
- Readability
- Maintainability
- Modularity
- Documentation

Second Priority
- Modernization
- Run-time Efficiency
TISA

• Baseline: Edition 4 code
• Short-term: low-hanging fruit
• Long-term: Infrastructure changes – C++
• Weekly code review meetings
• Use of:
  • Jira/Bitbucket/Confluence
  • “Understand” static code analysis tool
  • cpd (Copy-paste Detector)
LOW-LEVEL (Nov. ‘18)
- Remove “dead” code
- De-duplicate
- Generalize
- Collect multi-purpose routines for library

HIGH-LEVEL (Apr. ‘19)
- Designing future system
- Build general library
- Spatiotemporal flexibility
<table>
<thead>
<tr>
<th>Product</th>
<th>LoC Before</th>
<th>LoC After</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSF1deg</td>
<td>1,598</td>
<td>1,433</td>
<td>10.3%</td>
</tr>
<tr>
<td>SSF1deg-Hourly</td>
<td>11,835</td>
<td>11,718</td>
<td>0.9%</td>
</tr>
<tr>
<td>SSF1deg post-proc.</td>
<td>4,086</td>
<td>3,921</td>
<td>4.0%</td>
</tr>
<tr>
<td>SSF1deg-Month</td>
<td>20,275</td>
<td>16,941</td>
<td>16%</td>
</tr>
<tr>
<td>TSI</td>
<td>40,945</td>
<td>34,986</td>
<td>15%</td>
</tr>
<tr>
<td>GGEEO Driver</td>
<td>5,776</td>
<td>1,448</td>
<td>75%</td>
</tr>
<tr>
<td>GGEEO Daily/Monthly</td>
<td>8,729</td>
<td>5,929</td>
<td>32%</td>
</tr>
<tr>
<td>SYN1deg</td>
<td>34,847</td>
<td>31,248</td>
<td>11%</td>
</tr>
</tbody>
</table>
## TISA Code Reduction

<table>
<thead>
<tr>
<th>Product</th>
<th>LoC Before</th>
<th>LoC After</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSF1deg</td>
<td>1,598</td>
<td>1,433</td>
<td>10.3%</td>
</tr>
<tr>
<td>SSF1deg-Hourly</td>
<td>11,835</td>
<td>11,718</td>
<td>0.9%</td>
</tr>
<tr>
<td>SSF1deg post-proc.</td>
<td>4,086</td>
<td>3,921</td>
<td>4.0%</td>
</tr>
<tr>
<td>SSF1deg-Month</td>
<td>20,275</td>
<td>16,941</td>
<td>16%</td>
</tr>
<tr>
<td>TSI</td>
<td>40,945</td>
<td>34,986</td>
<td>15%</td>
</tr>
<tr>
<td>GGEOR Driver</td>
<td>5,776</td>
<td>1,448</td>
<td>75%</td>
</tr>
<tr>
<td>GGEOR Daily/Monthly</td>
<td>8,729</td>
<td>5,929</td>
<td>32%</td>
</tr>
<tr>
<td>SYN1deg</td>
<td>34,847</td>
<td>31,248</td>
<td>11%</td>
</tr>
</tbody>
</table>
Clouds

- Baseline: Edition 4 MODIS/VIIRS & GEO code
- Goals:
  - Clean up code
  - Generalize for enhanced library
  - Improve validation capabilities
  - Improve code documentation
Clouds

LOW-LEVEL (Nov. ’19)
- Remove “dead” code
- Remove unreachable code
- Decrease use of “magic numbers” (hard-coded values)

HIGH-LEVEL (Winter ’20)
- Collect core, common functionality into library
- Robust use of Git
- Improve validation strategy
Systems & CM
Production

• Production can be closed:
  • Production requests (PRs) in PR Tool
  • In-console CATALYST system

• PR Tool runs in OpenShift

• ALL PGEs RUN ON x86 MACHINES
Hardware Updates

- New x86 blades installed
  - Overall: 55% wall-time reduction
  - Biggest gain:
    - SYNI processing
    - 78% wall-time reduction

- Subsequent computers → virtualized

- CERES websites: migration in progress
Software Updates

• Accommodating SFTP

• Preliminary Instrument code delivery for Edition 2 NPP

• CERES websites: migration to new environments in progress
  • New CERES website design - Spring 2020
  • Working group pages - consolidation
Cloud-Compatibility

• PaaS: OpenShift
• Docker containers
• Production proof-of-concept:
  • TISA PGExs can run: 7.3.1P2, P3, and P4 (TSI)
  • On pace with MAIA production development
  • “Vertical slicing” next (chain)
ASDC Long-term Plans

- CERES as a SIPS
- De-coupling of archive and PGE data access/storage
- Pros:
  - More of a technical issue – we run production now
  - Ingest has been brittle – we can direct improved infrastructural design
- Cons:
  - Extricating responsibility/$ will take time
  - CERES itself will need more SA skill
Conclusions

- Technical capacity-building
  - Cloud/container technology
  - Software development
  - IT security compliance

- Production running well

- Preparing for new editions and data formats